TÜRK PEDİATRİ ARŞİVİ
TURKISH ARCHIVES of PEDIATRICS

Original Article

Zekai Tahir Burak Women's Health Education and Research Hospital newborn hearing screening results and assessment of the patients

İstemi Han Çelik[1], Fuat Emre Canpolat[2], Gamze Demirel[3], Zeynep Eras[4], Veli Gençay Sungur[5], Barış Sarıer[5], Uğur Dilmen[6]

[1]Clinic of Neonatology, Etlik Zübeyde Hanım Women's Diseases Education and Research Hospital, Ankara, Turkey
[2]Clinic of Neonatology, Zekai Tahir Burak Women's Health and Research Hospital, Ankara, Turkey
[3]Clinic of Neonatology, Samsun Women's and Children's Diseases Hospital, Samsun, Turkey
[4]Clinic of Developmental Pediatrics, Zekai Tahir Burak Women's Health and Research Hospital, Ankara, Turkey
[5]Clinic of Odiology, Zekai Tahir Burak Women's Health and Research Hospital, Ankara, Turkey
[6]Clinic of Neonatology, Zekai Tahir Burak Women's Health and Research Hospital and Yıldırım Beyazıt University, Ankara, Turkey

Abstract

Aim: Social, emotional, cognitive and language development of infants is provided with early diagnosis of hearing deficit. Hearing deficit is reported with a rate of 1-6 in 1000 live births in healthy newborns, while it reaches up to 10-30 in 1000 live births in newborns with risk factors. We aimed to compile the results of the hearing screening program applied in our hospital.

Material and Methods: The records of the hearing screening program were examined and the results were compiled by reaching the records of the patients who were found to have hearing deficit.

Results: Hearing test was applied in a total of 142 128 patients between 2005 and 2011. Hearing test was performed by evoked autoaucistic emission for two times in 26 690 of these patients and for three times in 2 412. A diagnosis of hearing deficit was made in 385 patients (0.27%) after application of ARB (Auditory Brainstem Response). The medical records of 171 of the patients who were referred for advanced investigations and treatment were obtained. 116 of these patients had a history of hospitalization in neonatal intensive care unit, while 55 patients had no history of hospitalization in neonatal intensive care unit. 49 of the patients had a gestational age below the 32th week and 122 had a gestational age above the 32th week. The median gestational age and birth weight values and ranges were found to be 35 (22-43) and 2 140 g (580-4 590 g), respectively. The risk factors included intrauterine growth retardation (n=24), multiple pregnancy (n=22), hyperbilirubinemia (n=74), blood exchange because of hyperbilirubinemia (n=7), sepsis (n=52), hypoglycemia (n=2), use of aminoglycoside and glycopeptide (n=99), use of furosemide (n=27), mechanical ventilation therapy (n=37), polycythemia (n=12), prenatal asphyxia (n=2), respiratory distress syndrome (n=45), chronic lung disease (n=11), surgery for retinopathy of prematurity (n=8) and hearing deficit in the mother or father (n=7).

Conclusions: In addition to the necessity of performing hearing screening in all newborns, infants with risk factors should be determined, hearing deficit should be screened with repeated hearing tests and social, emotional, cognitive and language development of the infant should be assured. (Türk Ped Arş 2014; 49: 138-41)

Key words: Hearing screening, risk factors, newborn

Address for Correspondence: İstemi Han Çelik, Clinic of Neonatology, Etlik Zübeyde Hanım Women's Diseases Education and Research Hospital, Ankara, Turkey. E-mail: istemihancelik@gmail.com

Received: 26.04.2013 **Accepted:** 16.01.2014

DOI:10.5152/tpa.2014.1207

Introduction

Infants with hearing deficit can be evaluated in the most inexpensive way with hearing screening programs in the neonatal period and can be diagnosed definitely (1-3). Social, emotional, cognitive and language development of infants is provided by early diagnosis of hearing deficit (4-6). Hearing deficit is reported with a rate of 1-6 in 1000 live births in healthy newborns, while it reaches up to 10-30 in 1000 live births in newborns with risk factors (1, 7, 8).

In our country, neonatal hearing screening started in Hacettepe and Marmara Universities for the first time. Since the year of 2000 maternity hospitals and other university hospitals have been added to the centers of screening and hearing screening is still being widely pursued (9).

In this study, it was aimed to evaluate the clinical and demographic properties of the infants who were found to have hearing deficit as a result of the review of the hearing screening program results of Zekai Tahir Burak Women's Health Education and Research Hospital and determine the risk factors.

Material and Methods

The Zekai Tahir Burak Women's Health Education and Research Hospital hearing screening program records belonging to 2005-2011 were examined. Conduction of the study was accepted with the decision of Zekai Tahir Burak Women's Health Education and Research Hospital Education Planning Coordination Committee (dated 16.06.2011, number 11). Medical records of the patients who were found to have hearing deficit were reached and their sociodemographic and clinical properties and risk factors were evaluated. The patients were divided into two groups as the group with a gestational age (GA) below 32 weeks and the group with a gestational age above 32 weeks. Hearing screening was performed by an odiometrist before the infant is discharged including holiday periods using autoaucistic emission (TEOAE, transient evoked otoacoustic emissions) method. The patients who failed the test for the second time were asked to come back 5 days later for a follow-up visit. If negatif result was obtained on follow-up examination performed with TEOAE, the auditory brainstem response (ARB) test was performed. The infants who were found to have unilateral or bilateral hearing deficit were referred to Hacettepe University Department of Otolaryngology, Odiology-Speech Disorders Unit. Hearing tests were performed using Echo Screen (Natus Medical Incorporated, San Carlos, CA, USA) device.

Statistical analysis

Statistical Program for Social Sciences (SPSS, New York, USA, version 20,0) was used for statistical analysis of the data. Chi-square test was used in assessment of numerical data. In assessment of the data which were expressed as measurement, t-test an done-way variance analysis were used when the variability test met the assumptions and Mann-Whitney U test and Kruskall Wallis test were used when the variability test did not meet the assumptions. A p value of <0.05 was considered significant.

Results

Hearing test was performed in a total of 142 128 patients who were born in our hospital between 2005 and 2011 before discharge. 26 690 of these patients were evaluated with TEOAE for the second time and 2 412 patients were evaluated with TEOAE for the third time (Table 1). 385 (0.27%) patients who

Table 1. Distribution of the babies in whom hearing test was performed by years

	First assessment	Second assessment	Third assessment	Referral
2005	24 315	4 328	395	83 (0.35%)
2006	21 975	4 065	422	53 (0.24%)
2007	22 556	3 823	414	57 (0.25%)
2008	21 432	3 834	385	58 (0.27%)
2009	16 982	3 885	194	55 (0.32%)
2010	17 572	3 628	347	41 (0.23%)
2011	17 296	3 127	255	38 (0.22%)
Total	142 128	26 690	2412	385 (0.27%)

Table 2. Risk factors belonging to the babies in whom hearing deficit was found

	≤32 GW (n=49)	>32 GW (n=122)	Total (n=171)
Aminoglycoside or glycopeptide	49	50	99 (57.9%)
Hyperbilirubinemia	47	27	74 (43.2%)
Sepsis	36	15	51 (29.8%)
Respiratory distress syndrome	45	-	45 (26.3%)
Mechanical ventilator	26	11	37 (21.6%)
Furosemide	11	16	27 (15.7%)
Intrauterine growth failure	12	12	24 (14%)
Mutiple pregnancy	14	8	22 (12.8%)
Congenital anomaly	1	18	19 (11.1%)
Chronic lumg disease	11	-	11 (6.4%)
Operation for retinopathy of prematurity	8	-	8 (4.6%)
Exhange transfusion	3	4	7 (4.1%)
Hypoglycemia	-	2	2 (1.1%)

% Number of patients with risk factor/total number of patients

were diagnosed with hearing deficit with auditory brainstem response test were referred for advanced investigations and treatment.

Medical records of 171 of the patients who were found to have hearing deficit could be reached. 116 of these patients were followed up by hospitalization in the neonatal intensive care unit (NICU). 55 patients were not hospitalized in NICU. 49 of the patients had a gestationa age below 32 weeks ans 122 patients had a gestational age above 32 weeks. The median gestational age and birth weight were 35 weeks (22-43) and 2 140 g (580-4 590 g), respectively. 87 of the patients were female and 84 were male.

The risk factors of the patients were evaluated (Table 2). Skeletal dysplasia (n=4), Down syndrome (n=3), cleft lip-palate (n=2), ventricular septal defect (n=2), atypical facial appearace (n=2), Smith-Lemni-Opitz syndrome (n=1), Treacher Collins syndrome (n=1), Pierre Robin syndrome (n=1), meningomyelocele (n=1), ichtiosis (n=1), microcephaly (n=1) were found in a total of 19 patients. Other risk factors included intrauterine growth reatardation (n=24), multiple pregnancy (n=22), hyperbilirubinemia (n=74), blood exchange because of hyperbilirubinemia (n=7), sepsis (n=52), hypoglycemia (n=2), use of aminoglycoside and glycopeptide (n=99), use of furosemide (n=27), mechanical ventilation theraphy (n=37), polystemia (n=12), prenatal asphyxia (n=2), respiratory distress syndrome (n=45), chronic lung disease (n=11), surgery for retinopathy of prematurity (n=8) and hearing deficit in the mother or father (n=7).

Intrauterine growth retardation, hyperbilirubinemia, sepsis and drug usage were found with a higher rate in the group with a lower gestational week ($p<0.001$). History of hearing deficit in the mother or father was present in 7 patients.

Discussion

Neonatal hearing screening is widely used in the whole world. Hearing screening which started in 1964 for the first time was performed primarily in patients who carried risk, whereas it is being performed in all infants currently (10, 11). In the literature, the risk factors which lead to hearing deficit have been reported to include a familial history of hereditary hearing deficit, low birth weigth, hyperbilirubinemia, use of ototoxic drugs, sepsis, meningitis, low APGAR and presence of mechanical ventilation (12, 13). While hearing deficit is expected in 2-5% of the infants who have these risk factors, no risk factor is found in 50% of the infants with hearing deficit (14, 15).

During the study period, hearing screening was performed in 142 128 newborns in our hospital and hearing deficit was found in 385 patients (0.27%). This rate is compatible with the rate reported in the literature (0.1-0.6%) (1, 7, 16). When the studies performed in our country were examined, it was found that Genç et al. (17) evaluated 12 665 newborns and reported the rate of hearing deficit to be 0.2%. In another study performed by Genç et al. (18), it was reported that a diagnosis of hearing deficit was made in 0.15% of 5 832 infants screened in Zübeyde Hanım Maternity Hospital and in 0.03% of 12 665 infants screened in Zekai Tahir Burak Women's Health Education and Research Hospital between 2000 and 2001. In a study performed in Uludağ University, Eryılmaz et al. (19) found no hearing deficit in 402 infants. According to the results of neonatal scrrening performed in Denizli, Polatlı and İstanbul, the rates of hearing deficit were reported to range between 0.1% and 0.15% (20-22). The finding that the rate hearing deficit found in our study was higher compared to the studies conducted in recent years may be explained with the fact that our study period was longer compared to the other studies, infants who were hospitalized in NICU were included in our study and the infants followed up in our hospital have more risk factors including premature delivery and congenital disorders compared to the other centers. In addition, it is notable that there is a decrease in the number of patients who are found to have hearing deficit in recent years in our hospital. This may be related with taking necesssary precautions by determining the risk factors which may lead to hearing deficit as well as improvement in prenatal care and the advancements made in the area of neonatology in recent years.

When the risk factors belonging to the infants who were found to have hearing deficit in our study were evaluated, it was observed that the most common risk factors included premature delivery, intrauterine growth reatardation, use of ototocix drugs including aminoglycozide, glycopeptide and furosemide, hyperbilirubinemia, exchange transfusion, sepsis, polystemia, various syndromes which especially involve the craniofacial region, mechanical ventilation therapy, familial history of hearing deficit and prenatal asphyxia. These risk factors should be considered when evaluating the patients. Especially premature infants have the potential to be exposed to multiple risk factors including hyperbilirubinemia, use of mechanical ventilation, sepsis and use of ototoxic drugs and the frequency of hearing deficit increases as the frequency of morbidity including retinopathy of prematurity and chronic lung disease increases. The risk factors which may facilitate hearing deficit should be determined when the patients are being followed up in NICUs and occurence of hearing deficit should be prevented by taking the necessary precautions. It should be kept in mind that hearing deficit are within the scope of the disease's natural course in clinical conditions including syndromes and cranio-facial anomalies and treatment should be initiated by making the diagnosis at an early period. The possibility of development of hearing deficit should be considered while determining the diagnostic, therapeutic and follow-up methods. In these patients, hearing tests should be repeated during the follow-up after discharge.

Our study is the largest study which reports neonatal hearing screening results and determines the risk factors in infants with hearing deficit in our country. Conclusively, hearing screening should be performed in each newborn baby and babies with risk factors should be determined, hearing deficit should be screened by repeated hearing tests and treatment should be started in a short period so that the baby's social, emotional, cognitive and language development is assured.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Zekai Tahir Burak Maternity Teaching Hospital (16.06.2011/11).

Informed Consent: This study was planned as a retrospective study and medical files were investigated for study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - İ.H.Ç., G.D.; Design - V.G.S, F.E.C; Funding - B.S., Z.E.; Data Collection and/or Processing - İ.H.Ç., G.D., B.S.; Analysis and/or Interpretation - İ.H.Ç.; Literature Review - F.E.C.; Writer - İ.H.Ç., G.D.; Critical Review - V.G.S., B.S., U.D.; Other - F.E.C.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Thompson DC, McPhillips H, Davis RL, Lieu TL, Homer CJ, Helfand M. Universal newborn hearing screening: summary of evidence. JAMA 2001; 286: 2000-10. [CrossRef]
2. Nekahm D, Weichbold V, Welzl-Mueller K, Hirst-Stadlmann A. Improvement in early detection of congenital hearing impairment due to universal newborn hearing screening. Int J Pediatr Otorhinolaryngol 2001; 59: 23-8. [CrossRef]
3. Kennedy CR, Kimm L, Dees DC, et al. Otoacoustic emissions and auditory brainstem responses in the newborn. Arch Dis Child 1991; 66: 1124-9. [CrossRef]
4. Oudesluys-Murphy AM, van Straaten HL, Bholasingh R, van Zanten GA. Neonatal hearing screening. Eur J Pediatr 1996; 155: 429-35. [CrossRef]
5. Mencher GT, Davis AC, DeVoe SJ, Beresford D, Bamford JM. Universal neonatal hearing screening: past, present, and future. Am J Audiol 2001; 10: 3-12.
6. Kennedy C, McCann D, Campbell MJ, Kimm L, Thornton R. Universal newborn screening for permanent childhood hearing impairment: an 8-year follow-up of a controlled trial. Lancet 2005; 366: 660-2. [CrossRef]
7. Hahn M, Lamprecht-Dinnesen A, Heinecke A, et al. Hearing screening in healthy newborns: feasibility of different methods with regard to test time. Int J Pediatr Otorhinolaryngol 1999; 51: 83-9. [CrossRef]
8. Chu K, Elimian A, Barbera J, Oqburn P, Spitzer A, Quirk JG . Antecedents of newborn hearing loss. Obstet Gynecol 2003; 101: 584-8. [CrossRef]
9. Bolat H, Bebitoglu FG, Ozbas S, Altunsu AT, Kose MR. National newborn hearing screening program in Turkey: struggles and implementations between 2004 and 2008. Int J Pediatr Otorhinolaryngol 2009; 73: 1621-3. [CrossRef]
10. Joint Committee on Infant Hearing position statement 1982. Ear Hear 1983; 4: 3-4. [CrossRef]
11. Joint Committee on Infant Hearing, American Academy of Audiology, American Academy of Pediatrics, American Speech-Language-Hearing Association, and Directors of Speech and Hearing Programs in State Health and Welfare Agencies. Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. Pediatrics 2000; 106: 798-817. [CrossRef]
12. Joint Committee on Infant Hearing 1990 position statement. ASHA Suppl 1991; 5 : 3-6.
13. Joint Committee on Infant Hearing. Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. Am J Audiol 2000; 9: 9-29. [CrossRef]
14. Vohr BR, Carty LM, Moore PE, Letourneau K. The Rhode Island Hearing Assessment Program: experience with statewide hearing screening (1993-1996). J Pediatr 1998; 133: 353-7. [CrossRef]
15. Joint Committee on Infant Hearing 1994 Position Statement. American Academy of Pediatrics Joint Committee on Infant Hearing. Pediatrics 1995; 95: 152-6.
16. Ghirri P, Liumbruno A, Lunardi S, et al. Universal neonatal audiological screening: experience of the University Hospital of Pisa. Ital J Pediatr 2011; 37: 16. [CrossRef]
17. Genç GA, Başar F, Kayıkçı ME, ve ark. Hacettepe Üniversitesi yenidoğan işitme taraması bulguları. Çocuk Sağlığı ve Hastalıkları Dergisi 2005; 48: 119-24.
18. Genç GA, Ertürk BB, Belgin E. Yenidoğan işitme taraması: başlangıçtan günümüze. Çocuk Sağlığı ve Hastalıkları Dergisi 2005; 48: 109-18.
19. Eryılmaz A, İleri O, Çakın M, ve ark. Uludağ Üniversitesi yenidoğan işitme taraması sonuçları. UÜ Tıp Fakültesi Dergisi 2009; 35: 27-9.
20. Ovet G, Balci YI, Canural R, et al. Our results of the hearing screening. Journal of Adnan Menderes University Medical Faculty 2010; 11: 27-9.
21. Kayiran SM, Genc E, Erdil A, Gurakan BA. Results of American Hospital newborn hearing screenin program. Turk Ped Arch 2009; 44: 135-7.
22. Renda L, Özer E, Renda R. Ankara Polatlı Devlet Hastanesi yenidoğan işitme taraması programı: 6 yıllık sonuçlar. Pamukkale Tıp Dergisi 2012; 5: 123-7.